JC18 Rec'd PCT/PTO 16 MAY 2001

FORM PTO-1390 (REV 10-94) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 01283/RSB

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 09/856024

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/08732	12 November 1999	17 November 1998

TITLE OF INVENTION: CATALYST ELEMENT FOR A RECOMBINATOR FOR THE EFFECTIVE ELIMINATION OF HYDROGEN FROM ACCIDENT ATMOSPHERES

APPLICANT(S) FOR DO/EO/US: Peter BROCKERHOFF; Werner VON LENSA: Ernst Arndt REINECKE

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [XX] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information:
    (i) Copy of WO 00/30121 (published application of PCT/EP99/08732)
    (ii) Copies of drawings (Figs. 1 to 6)
    (iii) Copy of PCT/RO/101 in PCT/EP99/08732
    (iv) Copy of PCT/IPEA/408 in PCT/EP99/08732
    (v) Copy of PCT/ISA/220 and PCT/ISA/210 (International Search Report in PCT/EP99/08732)
    (vi) Copy of PCT/IPEA/409 in PCT/EP99/08732

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Dorothy DeFrancesco

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01933

PATENT TRADEMARK OFFICE

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/856024	PCT/EP99/08732	01283/RSB

17. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):

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	CALCULATIONS	PTO USE ONLY
Search Report has been prepared by the EPO or JPO $860.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $750.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $1000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	19 - 20 =	–	x 18.00	$ –	
Independent claims	1 - 3 =	–	x 80.00	$ –	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ 270.00	$ –	
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also by filed (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$ 860.00	
				Amount to be: refunded	$
				charged	$

a. [X] A check in the amount of $ 860.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. ______________ in the amount of $______________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-1378. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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09/856024

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Attorney Docket No. 01283/RSB

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Peter BROCKERHOFF et al.

Serial No. : To be assigned (U.S. National Phase of PCT/EP99/08732, filed November 12, 1999)

Filed : Concurrently Herewith

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No.: EL 797 449 261 US
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I hereby certify that this paper is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 with sufficient postage on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231

Dorothy DeFrancesco

Dorothy DeFrancesco

In the event that this Paper is late filed, and the necessary petition for extension of time is not filed concurrently herewith, please consider this as a Petition for the requisite extension of time, and to the extent not tendered by check attached hereto, authorization to charge the extension fee, or any other fee required in connection with this Paper to Account No. 06-1378.

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

ATTENTION: BOX PCT

S I R :

Please amend the application as follows.

IN THE TITLE:

Revise the title to read as follows:

--RECOMBINATOR FOR ELIMINATING HYDROGEN FROM ACCIDENT ATMOSPHERES--.

IN THE SPECIFICATION:

Page 1, after the title and before the first paragraph, insert the following heading:

--BACKGROUND OF THE INVENTION

Field of the Invention--.

Page 1, between the first and second paragraphs, insert the following heading:

--Background Information--.

Page 3, between the second and third paragraphs, insert the following heading:

--SUMMARY OF THE INVENTION--.

Replace the paragraph bridging **pages 6 and 7** with the following paragraphs:

--The above components and those claimed and described in the embodiments to be used according to the invention are subject to no particular exceptional conditions relative to size, shape, material selection and technical concept, so that the selection criteria known in the area of application can be fully applied. Other details, features and advantages of the object of the invention arise from the ensuing description of the accompanying drawings, which depict preferred embodiments of the catalyst element according to the invention as an example.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a first embodiment of a catalyst element according to the invention with continuously varying coverage density of catalyst material, uncoated in the inflow area.

Fig. 2 shows a second embodiment of a catalyst element according to the invention with a strip-shaped surface coated with catalyst material running transverse to the direction of flow.

Fig. 3 shows a third embodiment of a catalyst element according to the invention with a strip-shaped coating with catalyst material running transverse to the direction of flow, wherein the coverage density of the strips increases in the direction of flow.

Fig. 4 shows a fourth embodiment of a catalyst element according to the invention with coated strips aligned along the overflow direction.

Fig. 5 shows a fifth embodiment of a catalyst element according to the invention with numerous strip-shaped basic bodies coated with catalyst material.

Fig. 6 shows a sixth embodiment of a catalyst element according to the invention with numerous strip-shaped basic bodies whose surfaces are sectionally coated with catalyst material.--

Page 7, before the last full paragraph and between lines 17 and 18, insert the following heading:

--DETAILED DESCRIPTION OF THE INVENTION--.

IN THE CLAIMS:

Please cancel claims 1 to 15, without prejudice.

Please add the following claims:

--16. (New) A recombinator for eliminating hydrogen from an accident atmosphere comprising

a catalyst element having a flat basic body, the flat basic body being arranged inside an area of flow through the recombinator, a surface of the flat body over which the accident atmosphere flows has a varying coverage density of catalyst material, the coverage density increases in the prescribed overflow direction.

17. (New) The recombinator according to claim 16, wherein the coverage density of the catalyst material varies continuously.

18. (New) The recombinator according to claim 17, wherein a front area of the flat basic body in the direction of flow is uncoated.

19. (New) The recombinator according to cam 16, wherein the surface of the flat basic body has coated sections and uncoated sections.

20. (New) The recombinator according to claim 19, wherein the surface of the flat basic body has strips comprising coated strips and uncoated strips.

21. (New) The recombinator according to claim 20, wherein the strips run transverse to the overflow direction.

22. (New) The recombinator according to claim 21, wherein the strips have a width which varies in the overflow direction.

23. (New) The recombinator according to claim 20, wherein the coverage density of the catalyst material of neighboring coated strips varies.

24. (New) The recombinator according to claim 20, wherein the strips run along the overflow direction.

25. (New) The recombinator according to claim 24, wherein the coated strips have a varying coverage density of catalyst material in the longitudinal direction.

26. (New) The recombinator according to claim 16, wherein a plurality of strip-shaped basic bodies are arranged in the area of flow through the recombinator.

27. (New) The recombinator according to claim 26, wherein the strip-shaped basic bodies run along or transverse to the direction of flow.

28. (New) The recombinator according to claim 26, wherein at least one of the heights and the coverage densities of the catalyst material of the strip-shaped basic bodies varies.

29. (New) The recombinator according to claim 17, wherein the surface of the flat basic body has coated sections and uncoated sections.

30. (New) The recombinator according to claim 21, wherein the coverage density of the catalyst material of neighboring coated strips varies.

31. (New) The recombinator according to claim 22, wherein the coverage density of the catalyst material of neighboring coated strips varies.

32. (New) The recombinator according to claim 17, wherein a plurality of strip-shaped basic bodies are arranged in the area of flow through the recombinator.

33. (New) The recombinator according to claim 19, wherein a plurality of strip-shaped basic bodies are arranged in the area of flow through the recombinator.

34. (New) The recombinator according to claim 27, wherein at least one of the heights and the coverage densities of the catalyst material of the strip-shaped basic bodies varies.--

IN THE ABSTRACT:

Please substitute the ABSTRACT OF THE DISCLOSURE submitted concomitantly herewith for the ABSTRACT as originally filed. A MARKED UP VERSION OF THE AMENDMENTS TO THE ABSTRACT is enclosed.

R E M A R K S

The specification was amended to provide section headings and was editorially revised. A MARKED UP VERSION OF THE AMENDMENTS TO THE SPECIFICATION is enclosed.

New claims 16 to 34 are supported in the original claims as follows:

Claims	Support in Original Claims
16	Claims 1 and 4
17	Claim 5
18	Claim 5
19, 29	Claim 6
20	Claim 7
21	Claim 8
22	Claim 9
23, 30, 31	Claim 10
24	Claim 11
25	Claim 12
26, 32, 33	Claim 13
27	Claim 14
28, 34	Claim 15

Respectfully submitted,

Richard S Barth

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Encls.: (1) MARKED UP VERSION OF THE AMENDMENTS TO THE ABSTRACT
(2) MARKED UP VERSION OF THE AMENDMENTS TO THE SPECIFICATION

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ABSTRACT OF THE DISCLOSURE

A recombinator for eliminating hydrogen from accident atmospheres. The recombinator serves to continuously and efficiently convert both small and large amounts of hydrogen contained in the atmospheric air-oxygen present in safety containers within a broad concentration range, and routes away the reaction heat arising in the process to such an extent that the ignition temperature is not reached in the mixture. The recombinator includes a catalyst element having a flat basic body, which is arranged within the area of flow through the recombinator. The surface of the basic body over which the accident atmosphere flows has a varying coverage density of catalyst material. The coverage density increases in the overflow direction.

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MARKED UP VERSION OF THE AMENDMENTS TO THE ABSTRACT

[The invention relates to a catalyst element for a] A recombinator for eliminating hydrogen from accident atmospheres[, in which the technical problem of]. The recombinator serves to continuously and efficiently [converting] convert both small and large amounts of hydrogen [with] contained in the atmospheric air-oxygen present in [the] safety containers within a broad concentration range, and [routing] routes away the reaction heat arising in the process to such an extent that the [respective] ignition temperature is not reached in the [present] mixture [is resolved by having the catalyst]. The recombinator includes a catalyst element [exhibit] having a flat basic body [(2)], which is arranged within the area of flow through the recombinator[, wherein]. [the] The surface of the basic body [(2)]over which the accident atmosphere flows has a varying coverage density [with] of catalyst material [(3)]. The coverage density increases in the overflow direction.

MARKED UP VERSION OF THE AMENDMENTS TO THE SPECIFICATION

Paragraph bridging pages 6 and 7:

The above components and those claimed and described in the embodiments to be used according to the invention are subject to no particular exceptional conditions relative to size, shape, material selection and technical concept, so that the selection criteria known in the area of application can be fully applied. Other details, features and advantages of the object of the invention arise from the ensuing description of the accompanying [drawing] drawings, which [depicts] depict preferred embodiments of the catalyst element according to the invention as an example. [The drawing shows:]

BRIEF DESCRIPTION OF THE DRAWINGS-

Fig. 1 shows a first embodiment of a catalyst element according to the invention with continuously varying coverage density [with] of catalyst material, uncoated in the inflow area[,].

Fig. 2 shows a second embodiment of a catalyst element according to the invention with a strip-shaped surface coated with catalyst material running transverse to the direction of flow[,].

Fig. 3 shows a third embodiment of a catalyst element according to the invention with a strip-shaped coating with catalyst material running transverse to the direction of flow, wherein the coverage density of the strips increases in the direction of flow[,].

Fig. 4 shows a fourth embodiment of a catalyst element according to the invention with coated strips aligned along the overflow direction[,].

Fig. 5 shows a fifth embodiment of a catalyst element according to the invention with numerous strip-shaped basic bodies coated with catalyst material[, and].

Fig. 6 shows a sixth embodiment of a catalyst element according to the invention with numerous strip-shaped basic bodies whose surfaces are sectionally coated with catalyst material.

Catalyst Element for a Recombinator for the Effective Elimination of Hydrogen from Accident Atmospheres

The invention relates to devices that can be used to eliminate released or accidentally formed hydrogen from non-inerted spaces, e.g., safety containers of pressurized water reactors and non-inerted boiling water reactors, which contain steam, air, aerosols and other gases in addition to hydrogen, effectively without backfiring. In this case, the hydrogen can be recombined into steam within the device in the presence of the existing atmospheric oxygen, e.g., in a catalytic procedure.

During the course of serious accidents, large amounts of hydrogen are formed in light-water reactors (LWR) due to the reduction of steam, which get into the safety containers. The maximal hydrogen amounts in both pressurized and boiling water reactors can measure about 20,000 m_n^3. There is also the danger that the atmospheric air in the safety containers (containments) will give rise to flammable mixtures, whose uncontrolled ignition and subsequent detonation places a serious dynamic compressive stress on the containment walls. In addition, steam and hydrogen always lead to pressure and temperature increases in the accident atmosphere. This is particularly significant in boiling water reactors, since their container volumes measure only about 20,000 m_n^3, in comparison to 70,000 m_n^3 in pressurized water reactors. Pressure and temperature increases result in an additional static stress on the containment walls. Further, leaks owing to excess pressure can give rise to the emission of radiotoxic substances.

Precautionary safety measures involve inerting the gas volumes with nitrogen, as has already been done for boiling water reactors. Catalytic recombinators represent countermeasures that have been discussed and partially implemented already. These are used to exothermally catalytically recombine the formed hydrogen both inside and outside the limits of inflammability, i.e., convert it into steam with the generation of heat. Hydrogen contents with concentrations lying within the limits of inflammability can also be burned off in a conventional manner after spark ignition. However, the resultant processes are not controllable, so that the system-jeopardizing reactions already mentioned above can arise under certain conditions.

In order to eliminate the hydrogen arising during normal operation and as the result of an accident, both thermal and catalytic recombinators were developed, which recombine the hydrogen with the oxygen in the air to form steam. Preference is given to catalytic systems, which operate passively, i.e., are self-starting and need no external power supply, so as to ensure availability during an accident. Substrates used in the known recombinators include metal plates or films as well as highly porous granulate, on which platinum or palladium is applied as the catalyst. Several films and granulate packets (the granulate is held together in packets by wire mesh) are arranged vertically and parallel to each other in sheet casings. The hydrogen/air mixture enters into the casing from below. The reaction starts on the catalytically coated surfaces. The mixture or reaction products stream over the substrate surfaces.

To date, the recombinators have made use of bilaterally coated plates or films and granulate packets. Their surfaces are homogenous, i.e., covered with constant amounts of precious metal. In addition, all catalyst elements are completely coated.

As a result, the dissipation of reaction heat from the systems is basically problematical. It is accomplished almost exclusively via convection from the solid surfaces on the gases streaming past, and heat radiation to neighboring structures. However, excessive hydrogen amounts can cause the coated substrates to become overheated, so that the ignition temperature is reached or exceeded, so that homogenous gas-phase reactions with deflagration or detonation can come about. One other disadvantage lies in the additional heating of the immediate environment of the substrates.

Therefore, the technical problem of this invention has to do with efficiently converting both small and large amounts of hydrogen with the atmospheric air present in the safety containers in a controlled fashion within a broad concentration range, and routing away the reaction heat arising in the process to such an extent that the respective ignition temperature is not reached in the present mixture.

The technical problem described above is resolved by a catalyst element for a recombinator for eliminating hydrogen from accident atmospheres, which has a flat basic body arranged inside the flow passage area of the recombinator, wherein the surface of the basic body

streamed over by the accident atmosphere is covered with varying coverage densities with catalyst material. In this case, it was recognized according to the invention that combining coated with uncoated or more or less coated areas affects both the reaction rates for hydrogen conversion and the cooling of the catalytic substrate. This is because the reaction heat is relayed into the uncoated areas via the heat conduction inside the basic body, and there passed by convection to the as yet unreacted cooler gases of the overflowing gas mixture. As a result, the level of hydrogen conversion can be suitably adjusted, wherein the large amounts of heat that come about during recombination are advantageously limited to a level that prevents the gas mixture of the accident atmosphere from igniting.

The basic body can essentially have any shape desired. However, the basic body is preferably designed as a plate or film, so that the gas mixture streaming over the surface of the basic body flows over a longer area in the coating specially fitted with catalyst material.

The basic body can essentially be at least partially covered by catalyst material on all sides, so that the entire surface of the basic body is optimally adjusted to the conversion of hydrogen. In another embodiment of this invention, the basic body has at least one uncoated and at least one coated side. Therefore, the uncoated side of the basic body can be completely used for dissipating the heat generated by the recombination. This is done on the one hand through heat radiation, and on the other by convection, i.e., by releasing the heat to the gas mixture streaming by.

In a particularly preferred embodiment of this invention, the coverage density with catalyst material on the surface of the basic body increases in the prescribed overflow direction. For this reason, the coverage density with catalyst material is at first slight as the flow streams over the surface of the basic body, since the share of hydrogen in the gas mixture is high, and the object is to keep down the level of hydrogen conversion to prevent excessive heat generation. As the flow continues to stream, the amount of catalyst on the surface rises to increase activity, since the share of hydrogen in the gas mixture tapers off over the running length, and hence the danger of ignition decreases too.

In this case, the surface coverage density also preferably varies continuously, wherein the surface of the basic body has coated sections and uncoated sections in another preferred embodiment of this invention. These sections are preferably strips, wherein the strips can be aligned both transverse and lengthwise to the overflow direction. Another variation of coverage density is achieved by varying the width of the strips in the overflow direction, or by varying the coverage density with neighboring catalyst material coated strips. In addition, the strips aligned along the overflow direction can have a varying, preferably rising coverage density with catalyst material in the longitudinal direction.

As evident from the different embodiments of this invention presented above, the underlying principle of a varying coverage density with catalyst material can be configured in numerous ways.

In addition, it is also possible to provide numerous strip-shaped basic bodies, which are arranged in the flow passage area of the recombinator. These strip-shaped basic bodies can here run along or transverse to the flow direction, wherein the heights and/or coverage density with catalyst material can vary in the strip-shaped basic bodies. While this eliminates a continuous surface along which the gas mixture can flow, the advantage is that areas in which the gas mixture mixes and/or settles come about in the gaps between the strip-shaped basic bodies, thereby resulting in a heat exchange and balancing of hydrogen concentration in the gas mixture.

The above components and those claimed and described in the embodiments to be used according to the invention are subject to no particular exceptional conditions relative to size, shape, material selection and technical concept, so that the selection criteria known in the area of application can be fully applied. Other details, features and advantages of the object of the invention arise from the ensuing description of the accompanying drawing, which depicts preferred embodiments of the catalyst element according to the invention as an example. The drawing shows:

Fig. 1 a first embodiment of a catalyst element according to the invention with continuously varying coverage density with catalyst material, uncoated in the inflow area,

Fig. 2 a second embodiment of a catalyst element according to the invention with a strip-shaped

surface coated with catalyst material running transverse to the direction of flow,

Fig. 3 a third embodiment of a catalyst element according to the invention with a strip-shaped coating with catalyst material running transverse to the direction of flow, wherein the coverage density of the strips increases in the direction of flow,

Fig. 4 a fourth embodiment of a catalyst element according to the invention with coated strips aligned along the overflow direction,

Fig. 5 a fifth embodiment of a catalyst element according to the invention with numerous strip-shaped basic bodies coated with catalyst material, and

Fig. 6 a sixth embodiment of a catalyst element according to the invention with numerous strip-shaped basic bodies whose surfaces are sectionally coated with catalyst material.

Embodiments relating to coatings for the surface of flat basic bodies will be described below. The arrows indicate the preferred directions in which the stream flows over the basic body. Double arrows indicate that both directions of flow are possible. However, in the case of non-homogenous coatings, only one overflow direction, namely in the direction of greater coverage density, is provided, since the hydrogen concentration in this direction tapers due to continuing recombination.

Fig. 1 shows the surface of a plate or film 2, which is uncoated in the inlet area, with an increasing amount of

catalyst material 3 in the direction of flow. In this case, a slight coverage density is initially used, since the share of hydrogen is high, and the principle of non-ignition through low reaction rates is to be observed. As the stream flows over, the catalyst amount increases in stages or continuously up to a maximal value at the outlet. A residual portion of the diluted mixture can still be decomposed there without an explosion despite higher temperatures, since the share of inerted gas constituents steam and nitrogen increases owing to the increasing oxygen and hydrogen consumption.

Fig. 2 shows a strip-coated plate or film 2. The height of the coated and uncoated strips 4 and 6 is adjusted to the desired reaction level, and can also be varied over the running length of the surface. On the uncoated strip 6, a portion of the reaction heat from the preceding strip 4 can be released into the substrate and on the surface. In addition, the free strips 6 are used for mixing the reacted and unreacted portions of the mixture. The back side of the depicted plate or film 2 can be coated in the same manner, or be completely uncoated.

Fig. 3 also shows a strip-coated plate or film. The amount of coating on the strips 4 increases with the running length in the overflow direction.

The embodiment on Fig. 4 shows coated strips 4 aligned in the direction of flow, in whose uncoated gaps, strips 6, a portion of the reaction heat can flow. The coverage density of the strips 4 can here be constant over the running length, or increase with the running length. Along the flow path, the already reacted gases, which

contain both hydrogen and nitrogen, mix increasingly with the hydrogen-containing gas routed over the cooling surfaces of the strips 6. Due to the changing concentrations with higher steam contents and lower oxygen contents, the ignitability of the mixture is subject to targeted reductions over the running length.

Fig. 5 shows bilaterally or unilaterally coated plate or film strips 8, whose height is freely selectable to reflect the desired reaction level per plate, and can therefore be optimized accordingly. For example, if the heights are reduced down to plate or film thickness, they approach the thickness of a „square" wire, i.e., the catalyst elements then consist only of adjacent, parallel thin structures. If the same arrangement with a circular cross section were to be additionally selected perpendicular thereto, a network would result. The height of the gaps is used to fix the size of the mixing and cooling zones. These gaps can also accommodate coolers to dissipate heat and avoid overheating of respectively ensuing catalytically active strips. For each of these structures, it must be ensured that overheating can be precluded at higher hydrogen contents.

Fig. 6 shows a division of coated plate or film strips 8 depicted on Fig. 5. The reaction on the surfaces and heat release through thermal conduction and convection can be controlled over the width of the coating in such a way that overheating cannot take place, and hence ignition temperatures cannot be reached or exceeded. In addition to the embodiment shown on Fig. 6, the coated and uncoated strips of neighboring plate or film strips can be offset relative to each other.

CLAIMS

1. A catalyst element for a recombinator for eliminating hydrogen from accident atmospheres

   - with a flat basic body (2) arranged inside the area of flow through the recombinator,

   - wherein the surface of the basic body (2) over which the accident atmosphere flows has a varying coverage density with catalyst material (3).

2. The catalyst element according to claim 1, characterized in that the basic body (2) is a plate or a film.

3. The catalyst element according to claim 1 or 2, characterized in that the basic body (2) has at least one uncoated side and at least one coated side.

4. The catalyst element according to one of claims 1 to 3, characterized in that the coverage density of the surface of the basic body (2) with catalyst material increases in the prescribed overflow direction.

5. The catalyst element according to one of claims 1 to 4, characterized in that the coverage density of the surface of the basic body (2) with catalyst material varies continuously, and preferably that the front area of the basics body (2) in the direction of flow is uncoated.

6. The catalyst element according to one of claims 1 to 4, characterized in that the surface of the basic body (2) has coated sections (4) and uncoated sections (6).

7. The catalyst element according to claim 6, characterized in that the surface has coated strips (4) and uncoated strips (6).

8. The catalyst element according to claim 7, characterized in that the strips (4, 6) run transverse to the overflow direction.

9. The catalyst element according to claim 8, characterized in that the width of the strips (4, 6) varies in the overflow direction.

10. The catalyst element according to one of claims 7 to 9, characterized in that the coverage density with catalyst material of neighboring strips (4) varies.

11. The catalyst element according to claim 7, characterized in that the strips (4, 6) run along the overflow direction.

12. The catalyst element according to claim 11, characterized in that the strips (4) have a varying coverage density with catalyst material in the longitudinal direction.

13. The catalyst element according to one of claims 1 to 12, characterized in that numerous strip-shaped

basic bodies (8) are provided, which are arranged in the area of flow through the recombinator.

14. The catalyst element according to claim 13, characterized in that the strip-shaped basic bodies (8) are arranged along or transverse to the direction of flow.

15. The catalyst element according to claim 13 or 14, characterized in that the height and/or coverage densities with catalyst material of the strip-shaped basic bodies (8) vary.

ABSTRACT

The invention relates to a catalyst element for a recombinator for eliminating hydrogen from accident atmospheres, in which the technical problem of continuously efficiently converting both small and large amounts of hydrogen with the atmospheric air-oxygen present in the safety containers within a broad concentration range, and routing away the reaction heat arising in the process to such an extent that the respective ignition temperature is not reached in the present mixture is resolved by having the catalyst element exhibit a flat basic body (2), which is arranged within the area of flow through the recombinator, wherein the surface of the basic body (2) over which the accident atmosphere flows has a varying coverage density with catalyst material (3).

Fig. 1

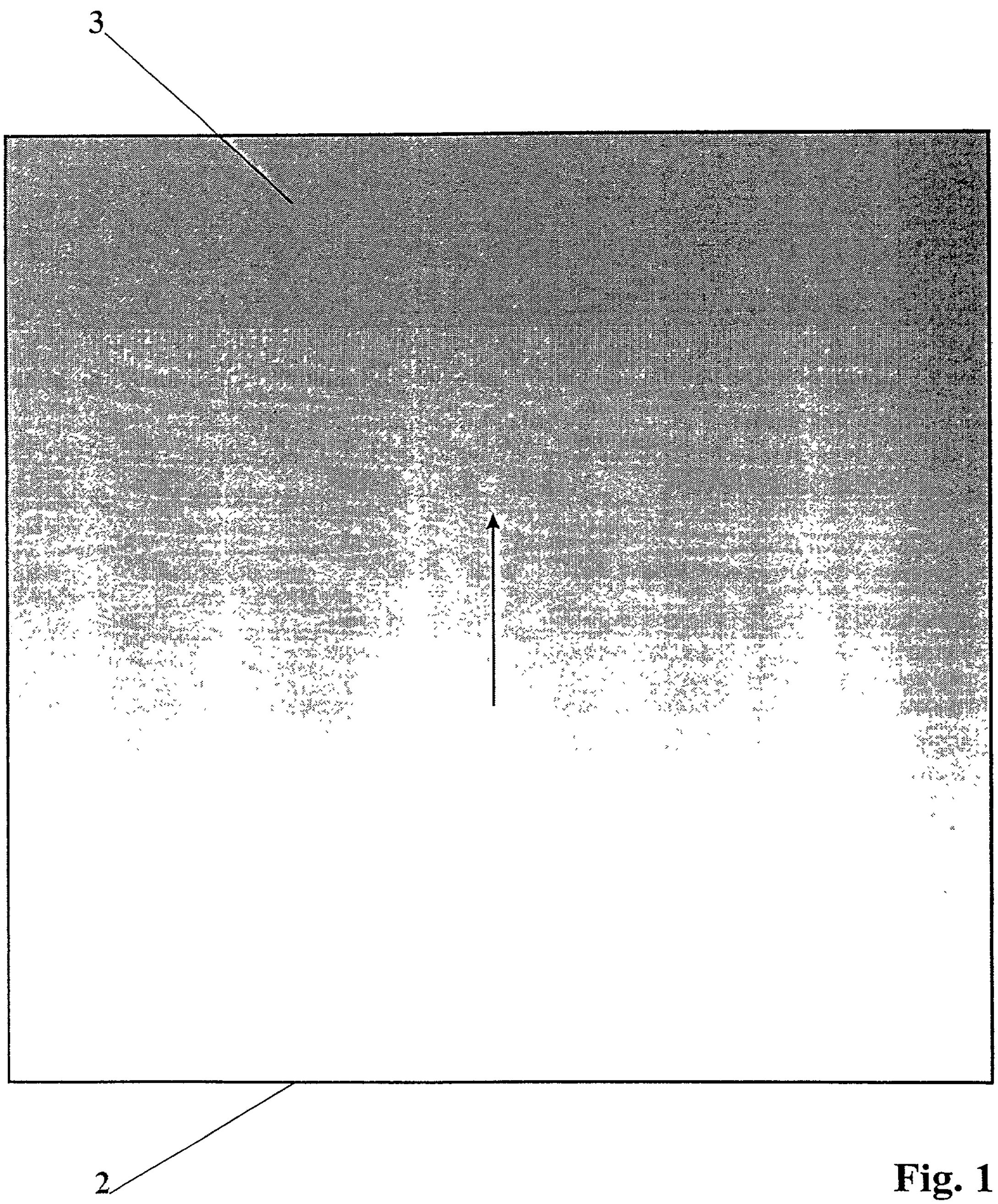

Fig. 1

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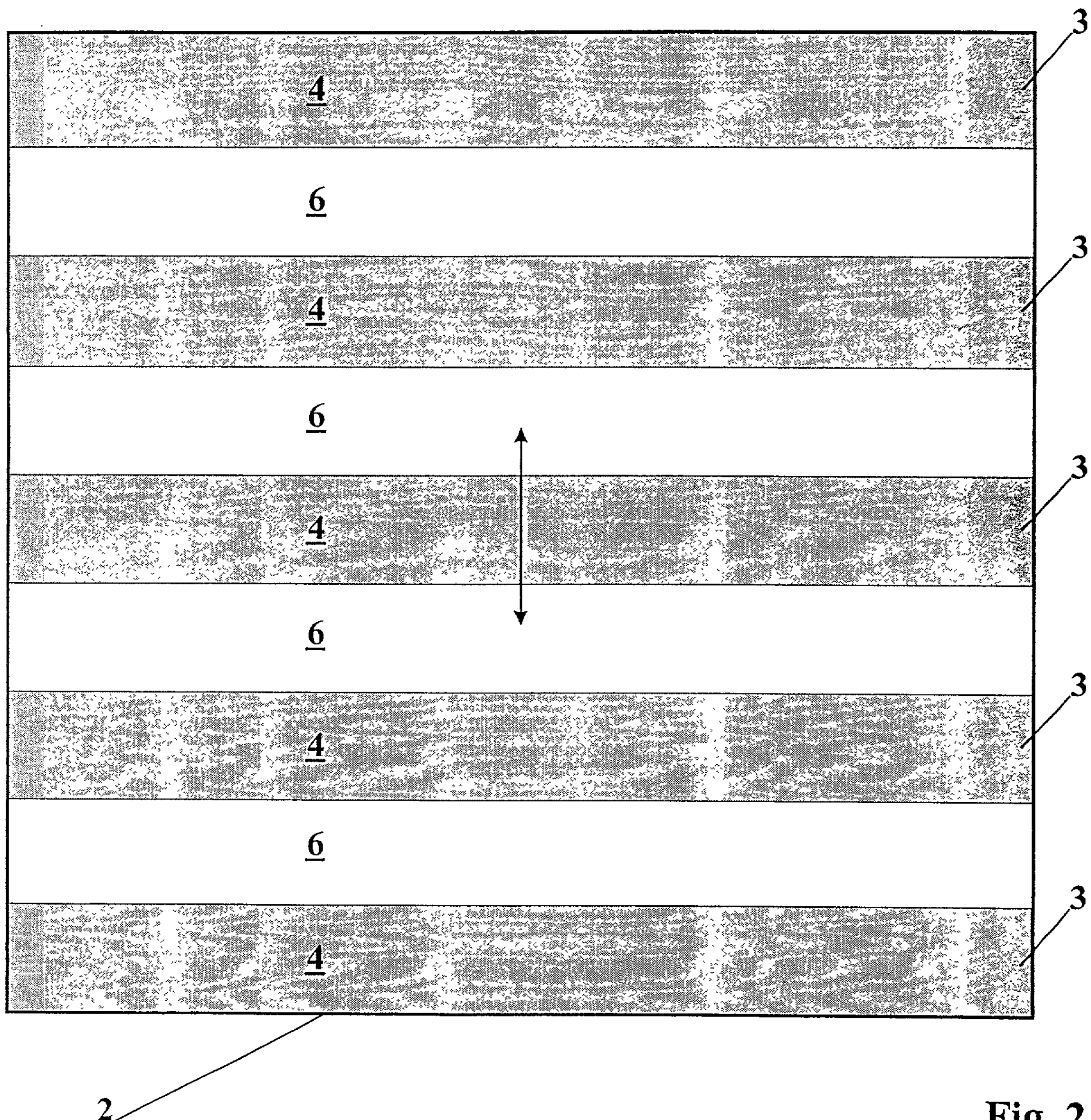

Fig. 2

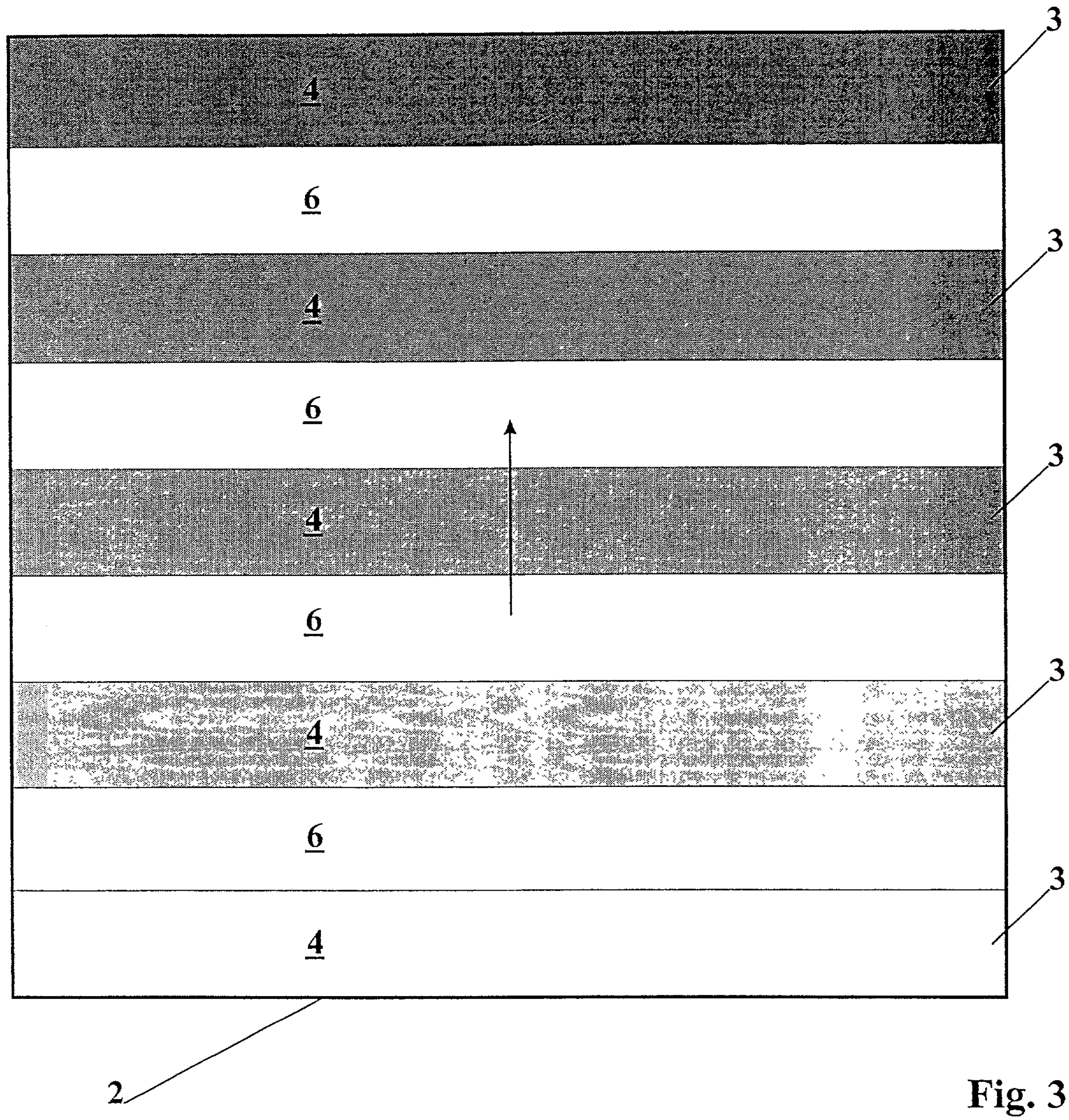

Fig. 3

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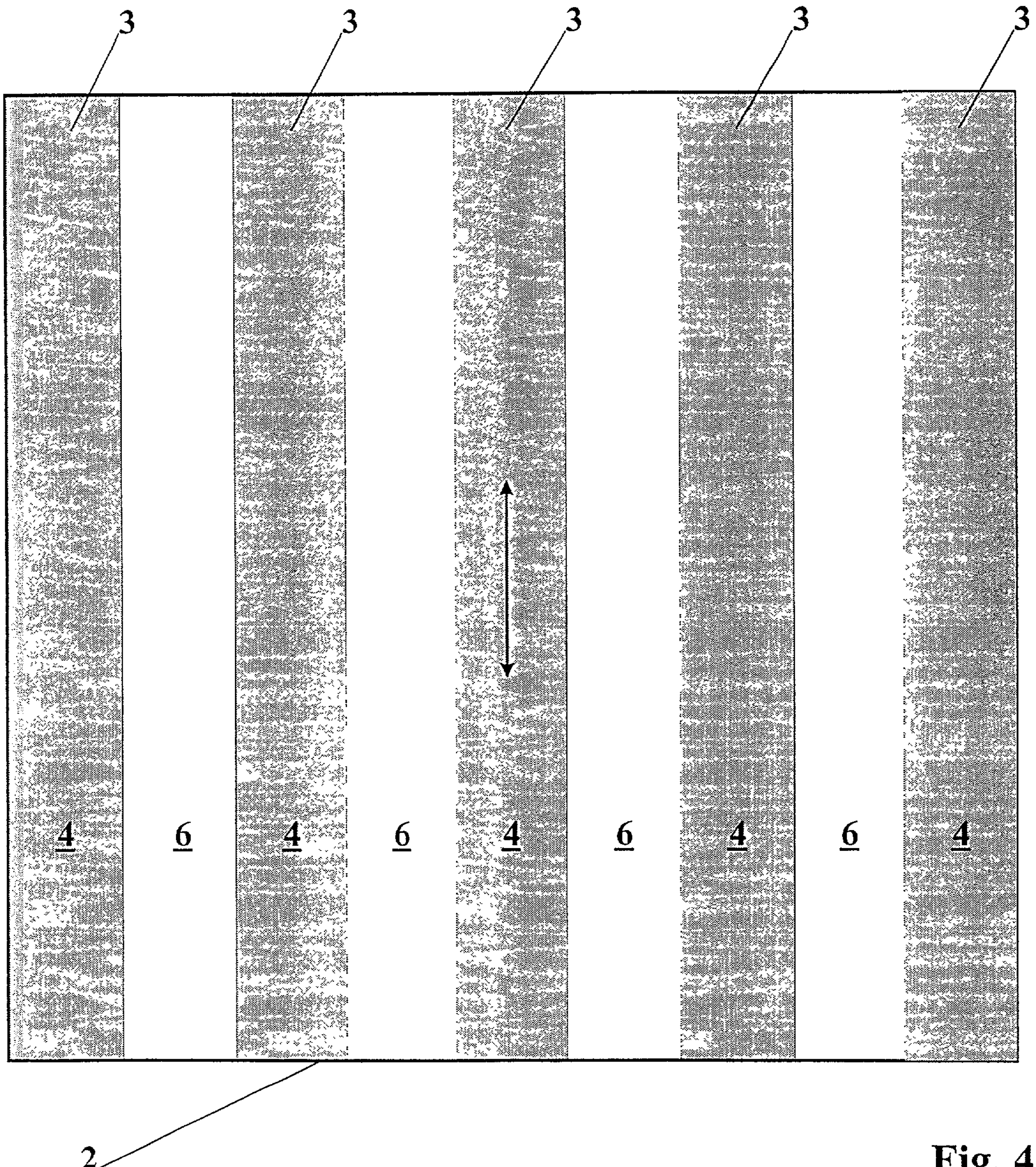

Fig. 4

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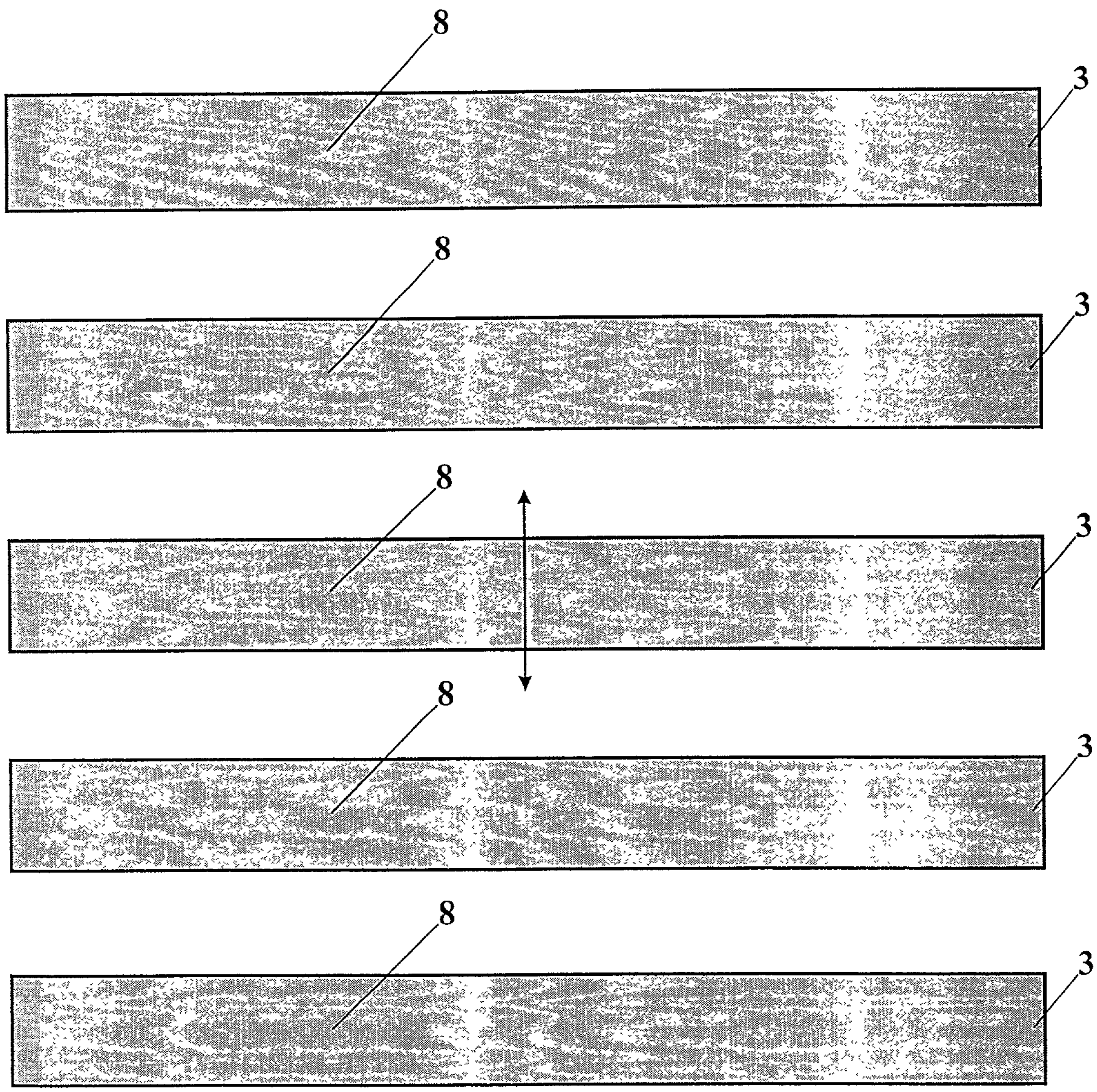

Fig. 5

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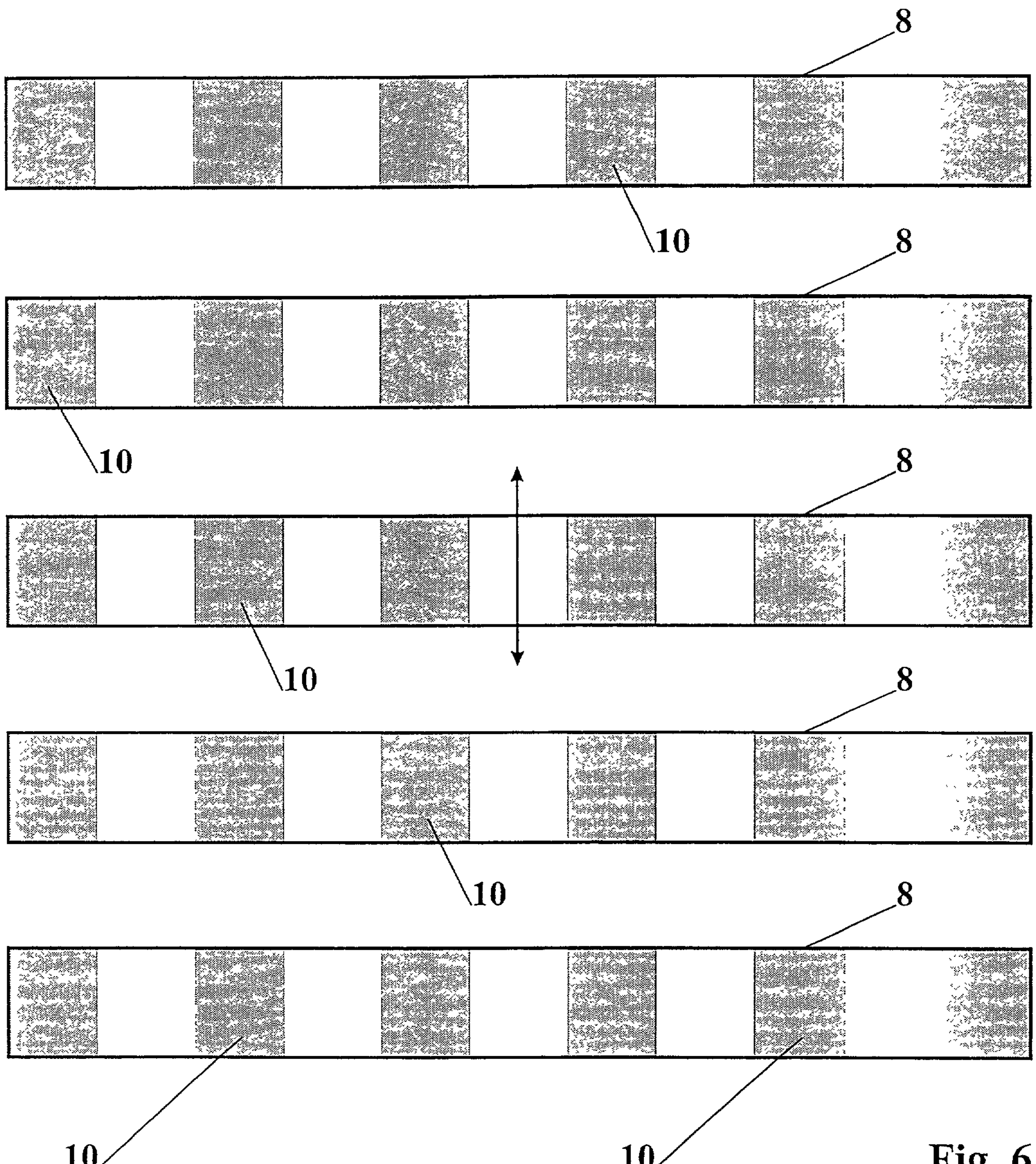

Fig. 6

10/96FHGL&C

U.S. Attorney Docket 01283/RSB

APPLICATION FOR UNITED STATES LETTERS PATENT
POST-FILED PCT Declaration and Power of Attorney (35 U.S.C. 371(c)(4))
PCT Application - United States Designated Office

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

RECOMBINATOR FOR ELIMINATING HYDROGEN FROM ACCIDENT ATMOSPHERES

described and claimed in serial number 09/856,024 deposited May 16, 2001, which is the national phase application of international application number PCT/EP99/08732 filed November 12, 1999;

I have reviewed and understand the contents of said specification, including claims.
I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I claim priority benefits under 35 USC §119 of: (i) any foreign application(s) for patent or inventor's certificate listed below; or (ii) any United States provisional application(s) listed below; and have also identified below any foreign application(s) for patent or inventor's certificate, or PCT international application having a filing date before that of the application(s) on which priority is claimed.

COUNTRY	APPLICATION NUMBER	DATE (day, month, year)	PRIORITY CLAIMED
Germany	198 52 953 .8	17, Nov. 1998	yes X no____
			yes____ no____

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I appoint the following attorneys to prosecute this application and to transact all business in the U.S. Patent & Trademark Office connected therewith: Leonard Holtz, Reg. No. ~~22,974~~; Herbert Goodman, Reg. No. ~~17,081~~; Thomas Langer, Reg. No. ~~27,264~~; Marshall J. Chick, Reg. No. ~~26,853~~; Richard S. Barth, Reg. No. 28,180; Douglas Holtz, Reg. No. 33,902; and Robert P. Michal, Reg. No. 35,614.

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